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Monitoring Micro-Structural Evolution and Crack Formation in a Solid Propellant under Incremental Strain Condition – Using Digital Radiograph X-Ray Techniques

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Monitoring Micro-Structural Evolution and Crack Formation in a Solid Propellant under Incremental Strain Condition-Using Digital Radiograph X-Ray Techniques

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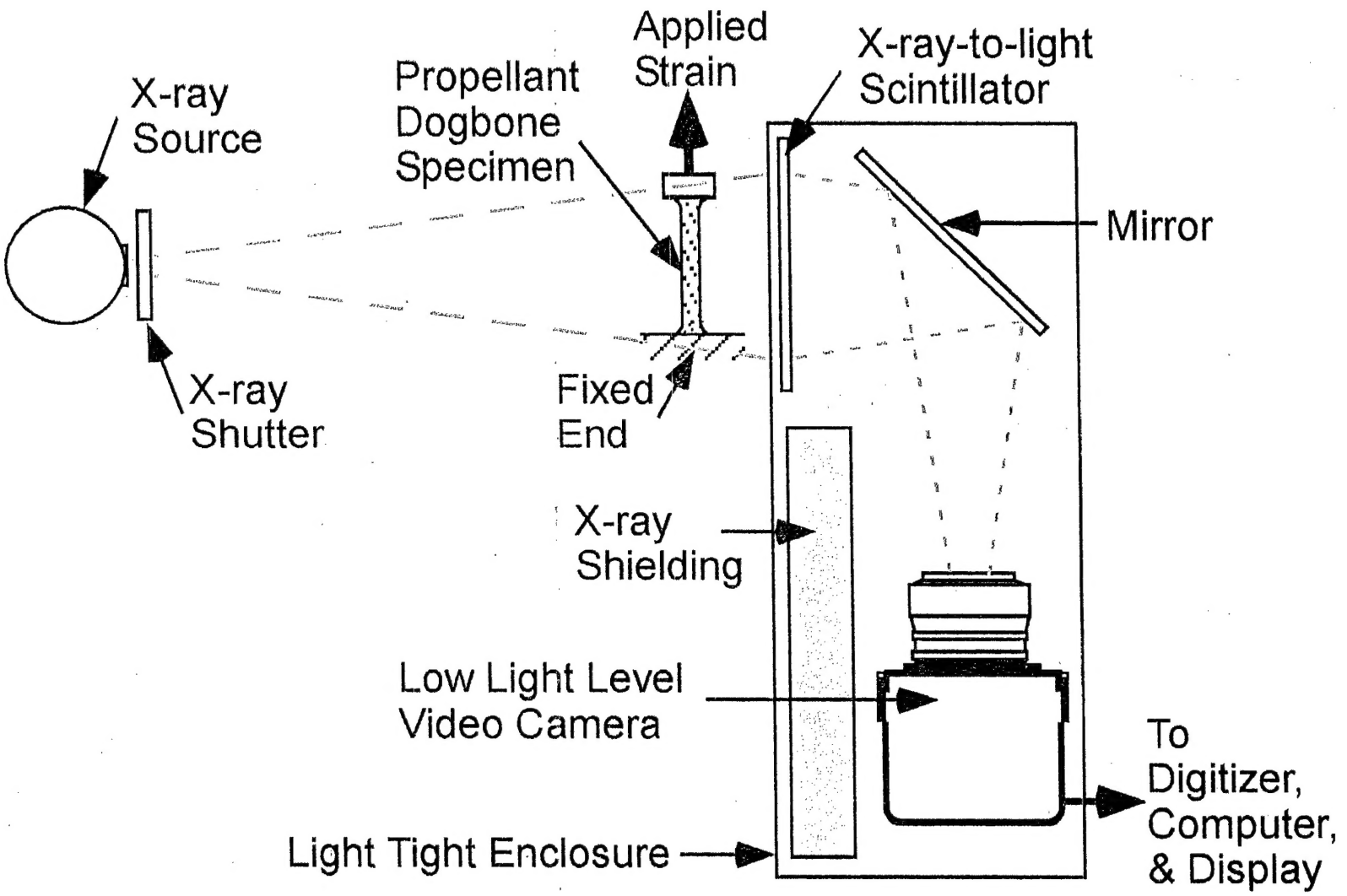
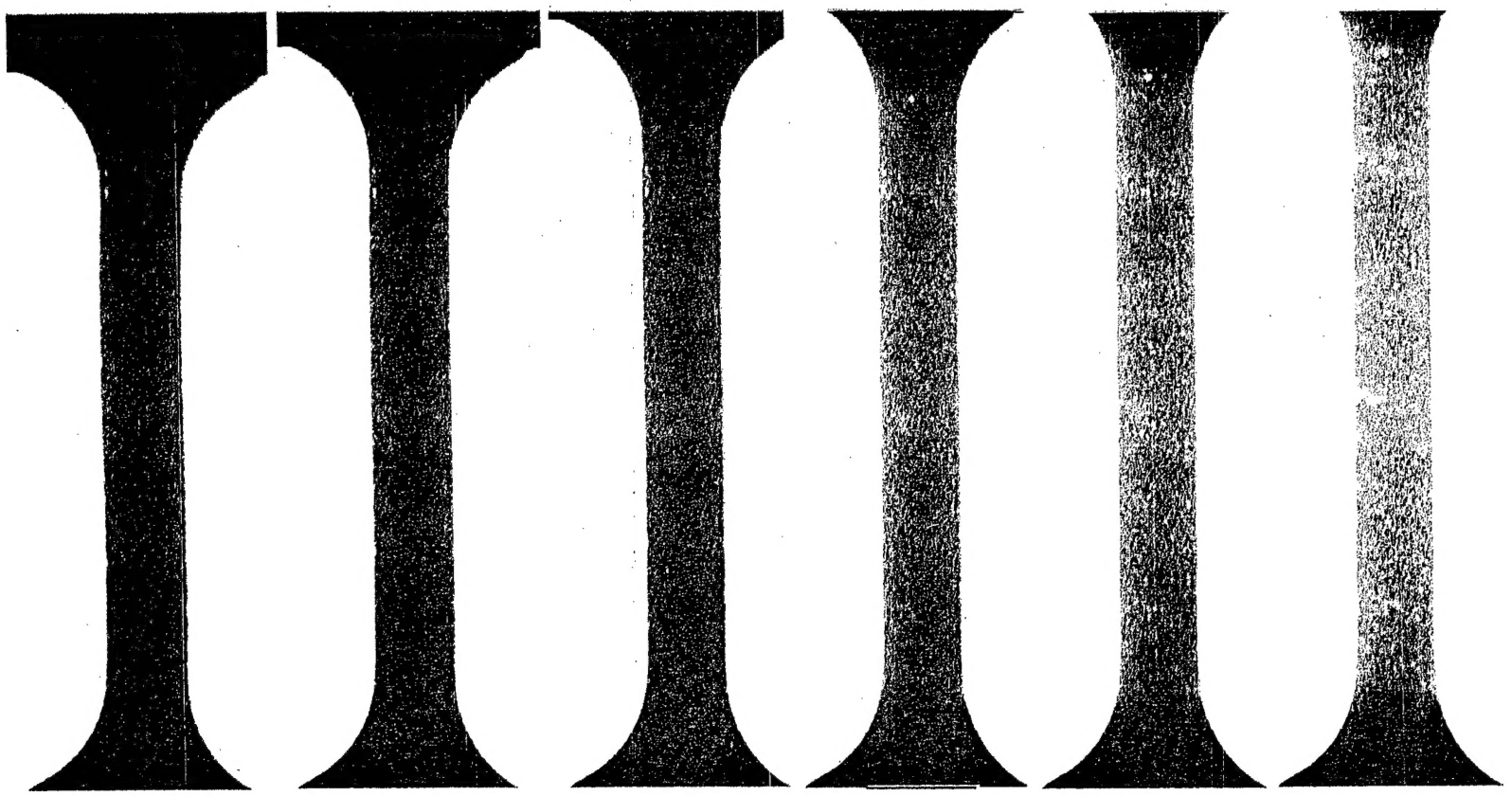
Objective

- **Monitor Micro-Structure Evolution, Damage process, and Crack Formation in a Solid Propellant.**

Testing Setup



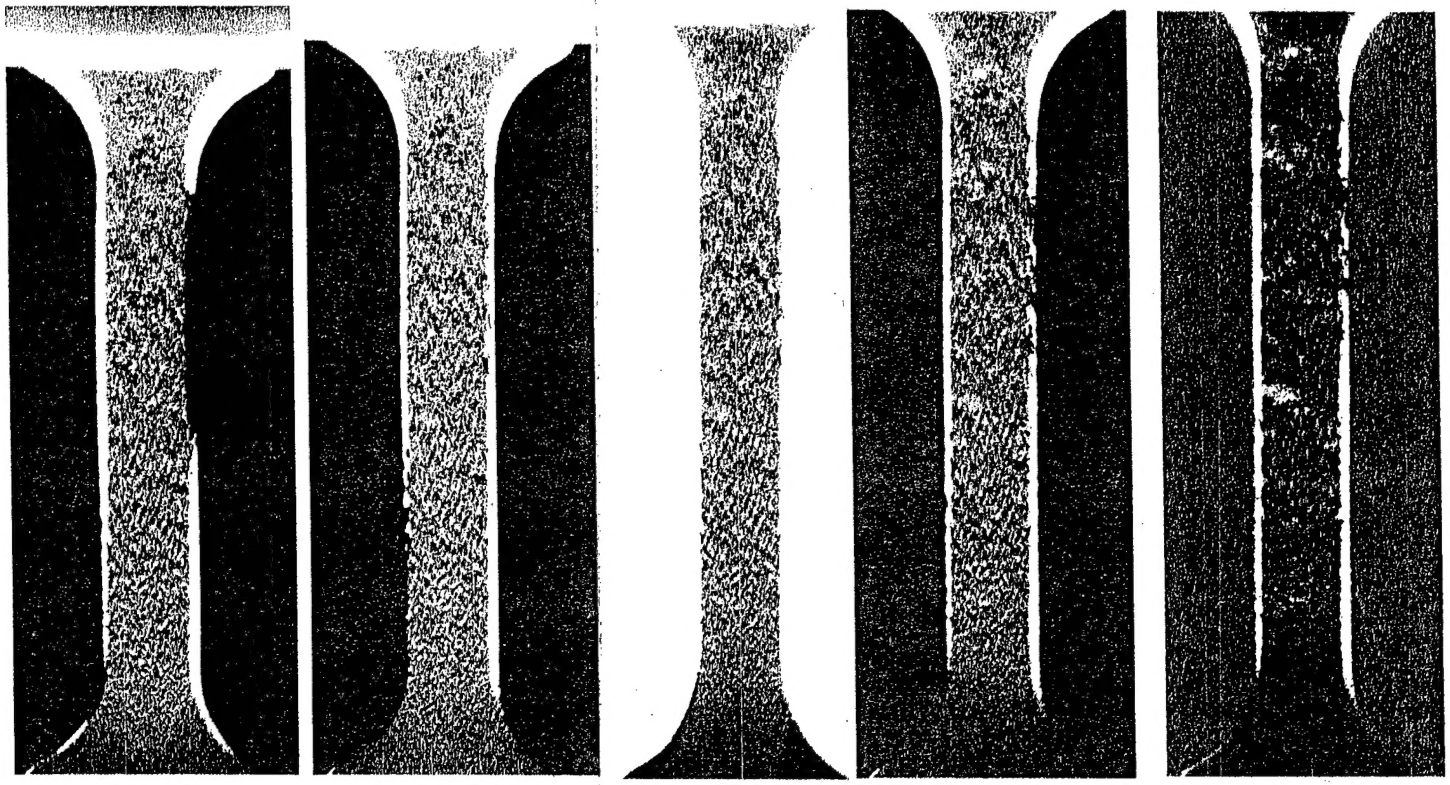
X-Ray Images at Different Amounts of Stretch



Unitestet_sample3_comp.jpg

Test Sample #3

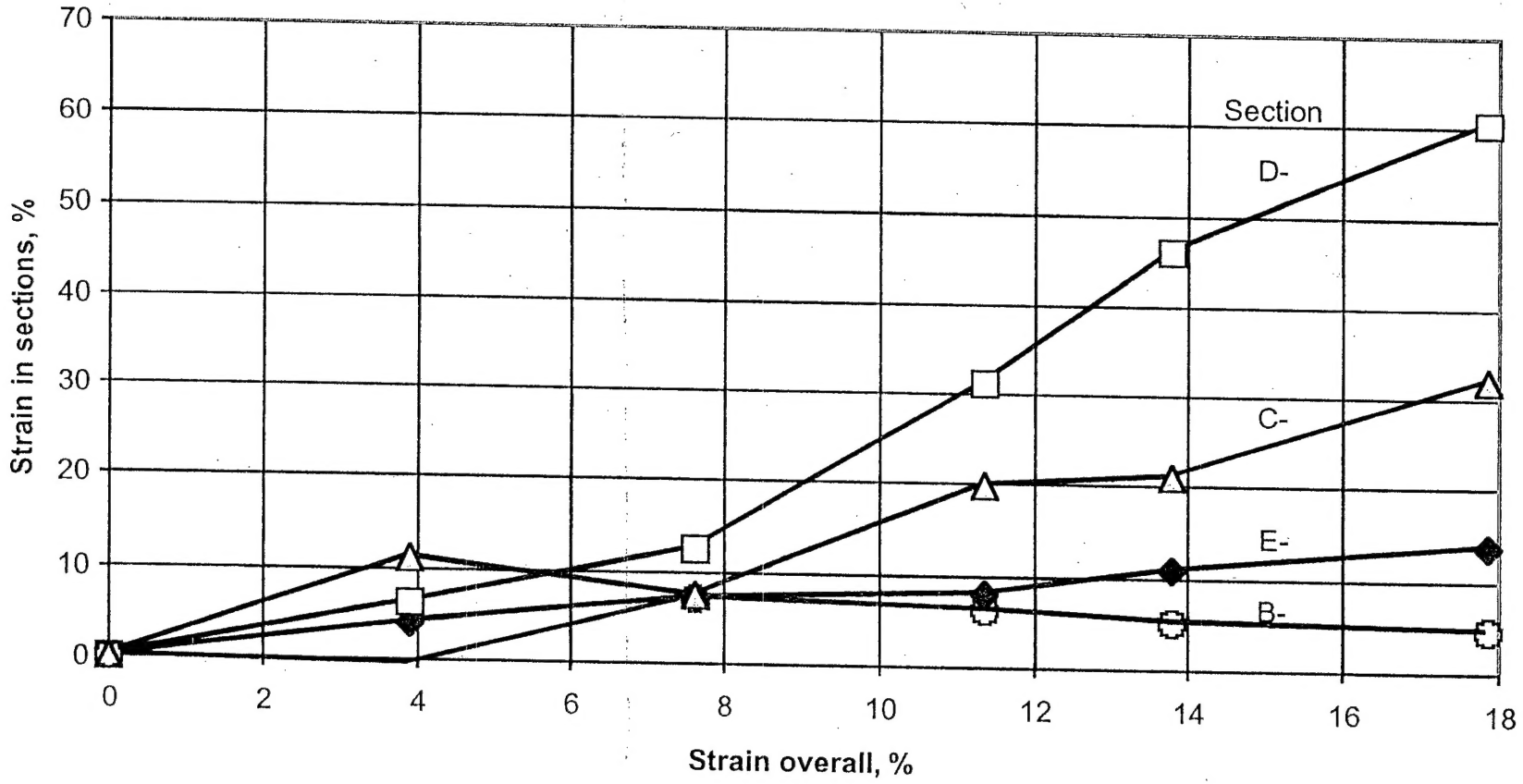
Difference X-Ray Images of the Change from One Stretch to the Next



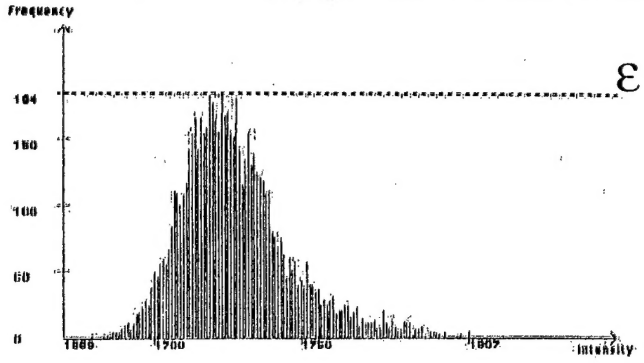
sample3_diff_comp.jpg

Difference Images for Sample #3

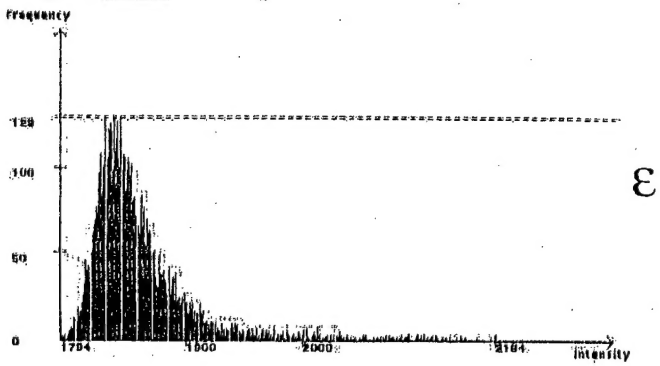
Section Strain as a Function of Applied Strain



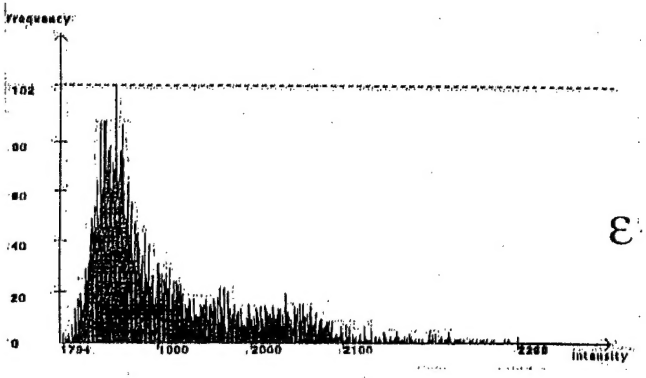
Histogram of X-Ray Intensity as Function of the Applied Strain at the Crack Location



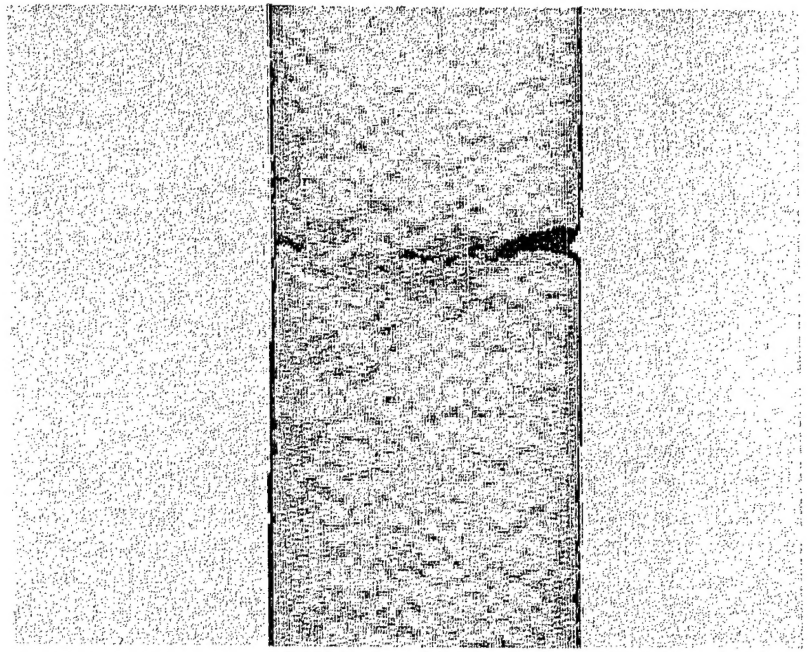
$\varepsilon = 0\%$



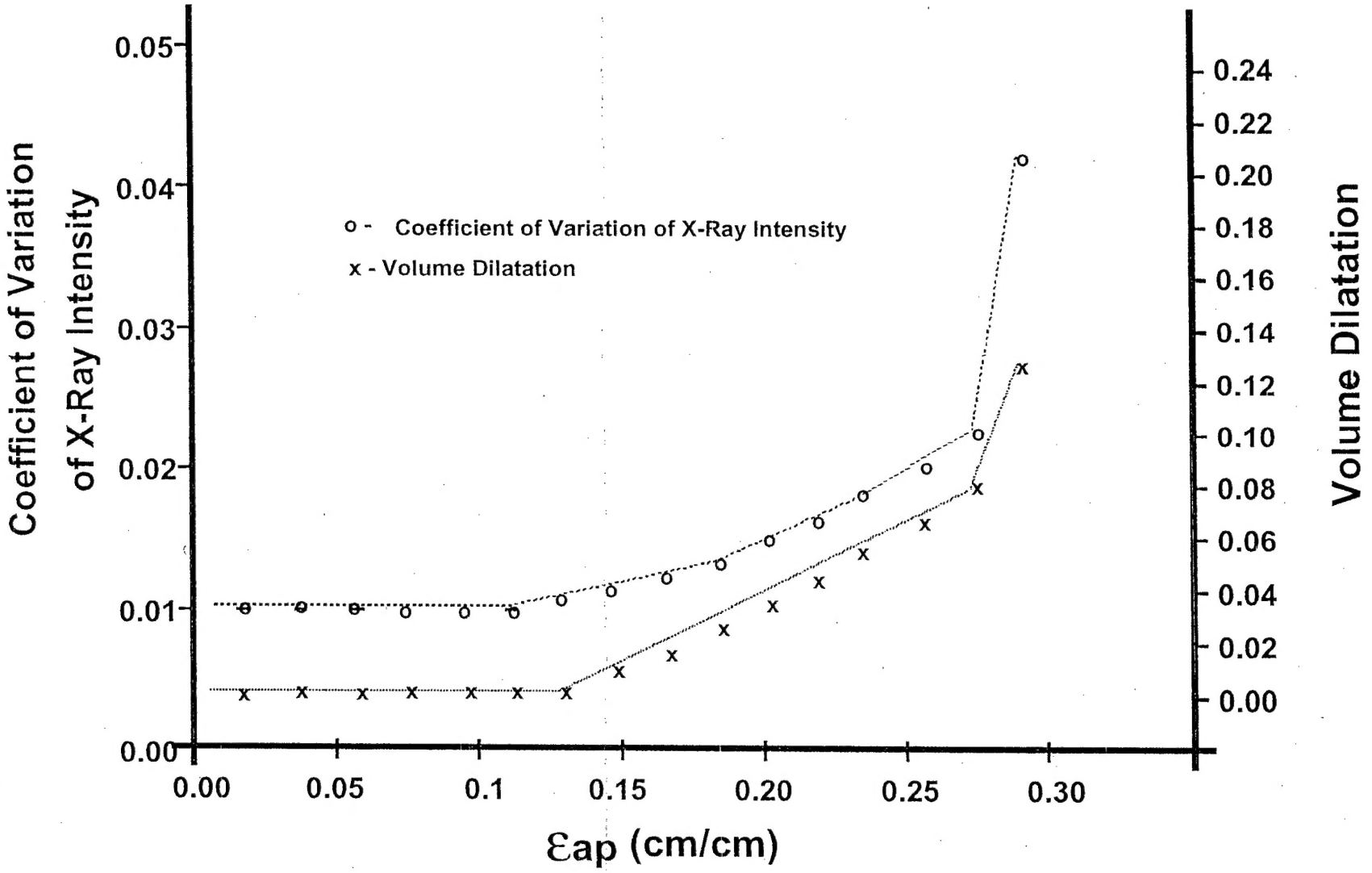
$\varepsilon = 27\%$



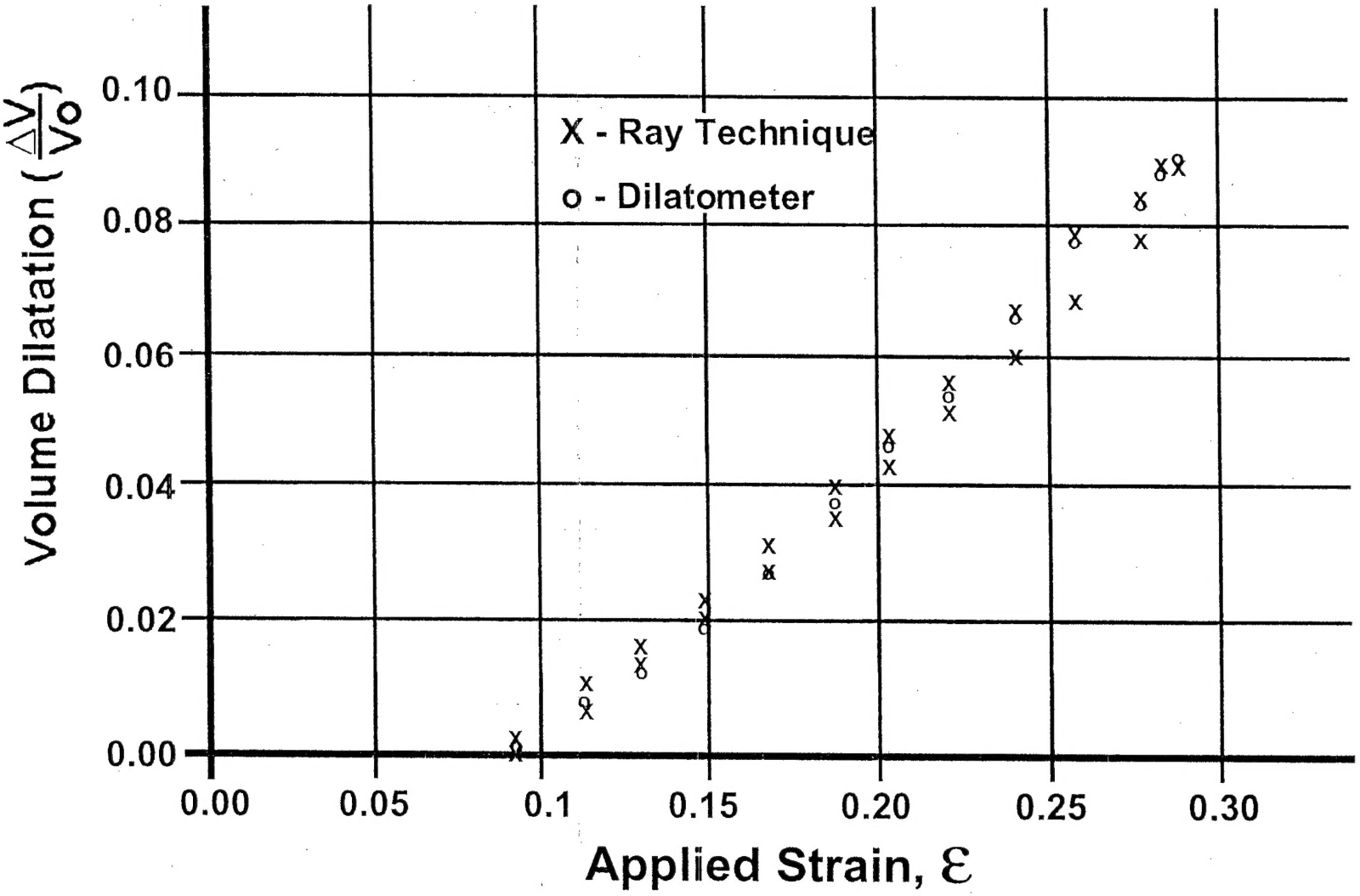
$\varepsilon = 29\%$



Coefficient of Variation of X-Ray Intensity and Volume Dilatation as Functions of Applied Strain



Volume Dilatation as a Function of Applied Strain



Conclusions

- The degree of inhomogeneity of material's micro-structure and number of non-propagating cracks increase as the applied strain is increased.
- The rate of x-ray intensity increases very fast prior to the formation of a crack.
- At high applied strain levels, the strain distributions are highly non-uniform.
- A good correlation exists between the dilatations measured by x-ray technique and dilatometer.
- X-ray technique is a promising method to monitor micro-structure change and crack formation in solid propellants.